

# Claims

- [c1] A method of forming a winding core for an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted relative to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole, comprising the steps of:
- providing a shaft having a keyway;
  - providing plates, each having radial poles with caps at the end of each pole and a key corresponding in shape to the keyway;
  - providing a stop on the shaft;
  - sliding each plate on the shaft following the keyway with the first plate bearing against the stop until a plurality of plates are mounted to the shaft;
  - compressing the plates to form a lamination; and
  - securing a lock nut on the shaft adjacent to the last plate to hold the lamination in compression.
- [c2] A method according to claim 1 wherein the compression

force is in a range of  $6 \times 10^4$  to  $10 \times 10^4$  Newtons.

- [c3] A method according to claim 1 wherein the stop is an annular shoulder formed in the shaft.
- [c4] A method according to claim 1 wherein the shaft has a longitudinal axis and the keyway is axially oriented at an acute angle relative to the longitudinal axis so the keyway is skewed on the shaft.
- [c5] A method according to claim 1 wherein a spacer is placed between the stop and the first plate.
- [c6] A method according to claim 1 wherein a spacer is placed between the last plate and the lock nut.
- [c7] A method according to claim 1 wherein about 980 plates are placed on the shaft.
- [c8] A method according to claim 1 wherein each plate is made of stamped tin and is about .35 mm thick before compression.
- [c9] A method according to claim 1 wherein the plates are compressed by a hydraulic press.
- [c10] A method according to claim 1 wherein the lock nut is threaded onto the shaft with sufficient torque to hold the lamination in compression.

[c11] A method according to claim 1 and comprising the step of wrapping wire around the radial poles.

[c12] A method of forming a winding core for an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted relative to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole, comprising the steps of:

providing a hollow cylindrical jig having at least one guide;

providing plates, each having a central opening, radial poles with caps at the end of each pole, and having a guide corresponding in shape to mate with the at least one guide in the jig;

providing a stop in the jig;

sliding each plate in the jig with the guide in the plate mating with the guide in the jig, and with the first plate bearing against the stop until a plurality of plates are disposed in the jig;

pressing a shaft into the central openings;

compressing the plates to form a lamination; and

securing a lock nut on the shaft adjacent to the last plate

to hold the lamination in compression.

- [c13] A method according to claim 12 wherein the guide in the jig is an axial rib and the guide in each plate is a notch.
- [c14] A method according to claim 12 wherein a spacer is disposed at each end of the lamination.
- [c15] A method according to claim 12 wherein the jig has a longitudinal axis and the guide on the jig is axially disposed at an acute angle relative to the longitudinal axis so that it is skewed in the jig.
- [c16] A method according to claim 12 wherein the acute angle is 10°.
- [c17] A method according to claim 12 wherein the compressing step and the pressing step occur simultaneously.
- [c18] A method according to claim 12 wherein the lock nut is threaded onto the shaft with sufficient torque to hold the lamination in compression.
- [c19] A method according to claim 12 and comprising the step of wrapping wire around the radial poles.
- [c20] A method according to claim 12 wherein the plates are compressed by a hydraulic press.